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Adie, J.W. , Duda, J.L. and Ntoumanis, N.

Editorial Manager(tm) for Motivation and Emotion
Manuscript Draft

Manuscript Number: MOEM156R2

Title: Autonomy support, basic need satisfaction and the optimal functioning of adult male and female sport participants: A test of basic needs theory

Article Type: Original Research

Section/Category:

Keywords: coach-created environment, sport motivation, self-determination theory, psychological development, well-being, mediation, gender invariance.

Corresponding Author: Mr james william adie, PhD

Corresponding Author's Institution: University of Birmingham

First Author: james william adie, PhD

Order of Authors: james william adie, PhD; Joan L Duda, PhD; Nikos Ntoumanis, PhD

Manuscript Region of Origin:

Running head: BASIC NEED SATISFACTION AND WELL-BEING IN SPORT

Autonomy support, basic need satisfaction and the optimal functioning of adult male and female sport participants: A test of basic needs theory

James W. Adie, Joan L. Duda, and Nikos Ntoumanis

University of Birmingham, UK.

Date Submitted: 21st November, 2006

Date of 1st Submission: 29th August, 2007

Date of 2nd Submission: 28th February, 2008

Address correspondence to: James Adie

University of Birmingham

Edgbaston, Birmingham, B15 2TT

UK

E-mail: JWA433@bham.ac.uk

Telephone: +44-121-414-8737

Fax: +44-121-414-4121

Abstract

Grounded in Basic Needs Theory (BNT; Ryan & Deci, 2000a), the present study aimed to: a) test a theoretically-based model of coach autonomy support, motivational processes and well-/ill-being among a sample of adult sport participants, b) discern which basic psychological need(s) mediate the link between autonomy support and well-/ill-being, and c) explore gender invariance in the hypothesized model. Five hundred and thirty nine participants (Male = 271; Female = 268; M_{age} = 22.75) completed a multi-section questionnaire tapping the targeted variables. Structural Equation Modeling (SEM) analysis revealed that coach autonomy support predicted participants' basic need satisfaction for autonomy, competence and relatedness. In turn, basic need satisfaction predicted greater subjective vitality when engaged in sport. Participants with low levels of autonomy were more susceptible to feeling emotionally and physically exhausted from their sport investment. Autonomy and competence partially mediated the path from autonomy support to subjective vitality. Lastly, the results supported partial invariance of the model with respect to gender.

KEYWORDS: coach-created environment, sport motivation, self-determination theory, psychological development, well-being, mediation, gender invariance.

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Perceptions of high energy and vitality are critical to physical and psychological functioning, and the experience of well-being, among sport participants. Diminished functioning and a sense of ill-being are evident when athletes perceive a loss of positive energy or feel emotionally and physically exhausted. The coach is a significant figure in the sporting environment who has the potential to influence the psychological and physical health and quality of engagement of an athlete or team of players. Grounded in basic needs theory (BNT; Ryan & Deci, 2000a), research has begun to examine the mechanisms linking dimensions of the coach-created environment to positive and negative indicators of players' welfare in the sports domain (Gagné, Ryan & Bargmann, 2003; Reinboth, Duda & Ntoumanis, 2004). The present study aimed to test the postulates of BNT among a sample of adult male and female sport participants.

BNT (Ryan & Deci, 2000a), a mini-theory of self determination theory (SDT; Deci & Ryan, 1985, 2000), proposes that humans function and develop effectively as a consequence of the social environment and its potential for basic need satisfaction. According to BNT, humans have three basic psychological needs; namely, the innate needs for autonomy, competence and relatedness (Deci & Ryan, 2000; Ryan & Deci, 2000a). The inherent need for *autonomy* (deCharms, 1968; Deci & Ryan, 1985) is fulfilled when people perceive that they are the origin of their choices and decisions, and that they are acting in accord with their integrated sense of self. *Competence* (White, 1959) concerns an individual's need to feel a sense of mastery through effective interaction within their environment. The third need, *relatedness,* corresponds to feeling securely attached to and being respected by significant others (Baumeister & Leary, 1995). Satisfaction of these psychological needs is assumed to directly enhance psychological and physical well-being (Deci & Ryan, 2000). When the three

basic psychological needs are thwarted however, ill-being is posited to ensue (Ryan & Deci, 2000a).

Contemporary conceptual approaches argue that well-being is not simply the absence of pain/displeasure or the mere presence of happiness/positive affect (Ryan & Deci, 2000b; 2001). Rather, from the *eudaimonic* perspective, well-being is defined in terms of self-realization and the degree to which a person is functioning optimally in a particular context (see Ryff, 1989; Waterman, 1993). SDT (and BNT more specifically) embraces the eudaimonic conceptualization of well-being (Ryan & Deci, 2001). In the present study, subjective vitality, a positive feeling of having available energy emanate from the self (Ryan & Frederick, 1997), was targeted as a key indicator of eudaimonic well-being. The emotional and physical exhaustion facet of burnout (Raedeke & Smith, 2001), was assessed as an index of ill-being. In this way, we attempted to capture both the brighter and darker sides of athletes' sporting life (Ryan & Deci, 2000b).

With respect to social environmental factors that are assumed to be important for need satisfaction and ensuing well-being (Ryan & Deci, 2000a), emphasis has been placed on the degree of *autonomy support* (Deci & Ryan, 1987) provided by significant others in the context in question. Autonomy support is evident when an authority figure respects and takes the subordinate's perspective, promotes choice and encourages decision-making. An autonomy supportive environment is assumed to foster participants' sense of personal autonomy and perceptions that they are the origin of their behavior. Previous studies in a variety of contexts have supported this theoretical prediction (Ratelle, Larose, Guay & Senécal, 2005; Reinboth et al., 2004; Standage, Duda, & Ntoumanis, 2006). Autonomy support is also posited to facilitate the needs for competence and relatedness (Ryan & Solky, 1996; Mageau & Vallerand, 2003) and research in sport (Smith, Ntoumanis & Duda, 2007),

the workplace (Baard, Deci & Ryan, 2004) and classroom settings (Ratelle et al., 2005) has corroborated this assumption.

In the sport setting specifically, the coach can be considered to be the most proximal contact for all athletes on a team and consequently plays a key role in nurturing their needs for autonomy, competence and relatedness (Mageau & Vallerand, 2003; Smith et al., 2007). Grounded in the BNT framework, sport research has begun to test the hypothesized links between perceptions of the coach-created environment, basic need satisfaction, and indices of athletes' welfare (Gagné et al., 2003; Reinboth et al., 2004). Gagné and associates (2003) conducted a diary-based study among a group of female adolescent gymnasts and found fluctuations in daily need satisfaction to predict changes in daily well-being (operationalized as levels of vitality, self-esteem, and positive and negative affect). In a cross-sectional study of young adolescent male soccer and cricket players, Reinboth and colleagues (2004) investigated how different aspects of the coach-created environment predicted athletes' need satisfaction and ensuing indices of well- and ill-being. They found that autonomy support, the degree of mastery focus and social support positively corresponded to reported satisfaction of the needs for autonomy, competence, and relatedness, respectively. In turn, the needs for autonomy and competence predicted higher levels of vitality and intrinsic interest. Low levels of perceived competence were associated with more frequent reports of physical ill-health symptoms (e.g., headaches).

BNT assumes the psychological needs essential for optimal functioning are universal (Ryan & Deci, 2000a). However, Ryan and Deci (2000a) suggest that the degree of influence of social environmental factors supporting need satisfaction may not necessarily be consistent across the lifespan. Thus, with respect to the existent research conducted in the sport domain, testing the tenets of BNT among older participants would advance theoretical knowledge. For example, the immediate environment created by the coach may hold differential significance

for senior athletes when compared to their younger counterparts because of the extensive sport experience and greater maturity of the older sport participants. Moreover, feelings of competence, autonomy, and relatedness may not correspond to indicators of health and engagement quality among older competitors to the same degree and/or in the same manner as has been found for young sport participants. To our knowledge, only one BNT-based study has moved beyond the inclusion of youth sport participants. In research involving university student-athletes, Reinboth and Duda (2006) found that the task-involving features of the coach climate predicted need satisfaction. Satisfaction of the needs for autonomy and relatedness were linked to players' reported subjective vitality over the course of a season. Interestingly, the need for competence was unrelated to vitality and physical ill-health symptoms within this older age-group sample. However, this study did not consider the degree of autonomy support provided by the coach. Extending the extant sport research testing BNT (Gagné et al., 2003; Reinboth & Duda, 2006; Reinboth et al., 2004), the present study examined the hypothesized sequence between the autonomy supportive aspect in the coach-created environment to need satisfaction to indices of well- and ill-being in the case of adult sport participants.

Aligned with self determination theory (Mageau & Vallerand, 2003; Ryan & Deci, 2000a) and previous work in the physical domain (Smith et al., 2007; Standage et al., 2006), we hypothesized that perceptions of autonomy support would positively predict satisfaction of the needs for autonomy, competence and relatedness (Hypothesis 1). Based on the tenets of BNT (Ryan & Deci, 2000a) and past sport research by Reinboth and colleagues (2004), we proposed that satisfaction of the three psychological needs would predict feelings of vitality (Hypothesis 2a), whereas low need satisfaction would link to greater emotional and physical exhaustion (Hypothesis 2b).

The second aim of this study was to examine why the autonomy supportive features of the coach-created environment might predict positive and negative indicators of athletes' welfare. Deci and Ryan (2000) argue that the psychological needs represent the "why" of goal pursuit or, central to the focus of this study, the mechanisms by which the social environment impacts on motivation, psychological health and well-being. Specific to the sport domain, Mageau and Vallerand (2003) propose that the three psychological needs *mediate* the link between coach autonomy support and healthy outcomes. In previous research examining the social environment-optimal functioning relationship, the expected mediational role of the needs has been assumed but not tested (e.g., Baard et al., 2004; Reinboth et al., 2004) or examined via regression analyses (e.g., Reinboth & Duda, 2006) in accordance to the recommendations of Baron and Kenny (1986).

Extending previous work, we examined the mediational effects of the three psychological needs from an autonomy supportive climate to positive and negative indices of athletes' welfare via structural equation modeling (SEM; Holmbeck, 1997). Two benefits of testing mediation via SEM rather than conventional regression analyses are that a) multiple outcome variables can be examined simultaneously, and b) this analytical approach controls for measurement error. Moreover, moving beyond previous SDT-based studies which have determined the potential mediating role of a composite index of basic need satisfaction (e.g., Hagger, Chatzisarantis & Harris, 2006; Standage, Duda & Ntoumanis, 2005), we tested via SEM which specific basic need(s) would mediate the hypothesized relationship between autonomy support and indices of well- and ill-being. In accordance with theoretical predictions (Mageau & Vallerand, 2003) and previous findings in the educational and sport domains (Ratelle et al., 2005; Reinboth & Duda, 2006), we expected that all three basic needs would mediate the relationship from coach autonomy support to the targeted indicators of well- and ill-being (Hypothesis 3).

The final major purpose of the study was to test our model for gender invariance. Ryan and Deci (2000a) argue that the motivational processes essential for human functioning are equivalent across gender groups. To our knowledge, this proposition has not received empirical attention in the physical domain. This is because previous BNT-based sport studies have either employed single sex samples (Gagné et al., 2003; Reinboth et al., 2004), or have assumed the link between basic needs satisfaction to well-being to be equivalent for male and female participants (Reinboth & Duda, 2006). To address these limitations, we conducted multi-sample SEM analyses to ascertain whether male and female athletes interpreted an autonomy supportive climate, psychological needs, and indices of well-/ill-being in a similar manner (i.e., we tested measurement invariance). We further examined whether the theoretical (Ryan & Deci, 2000a) links between the coach-created environment, need satisfaction, and markers of well- and ill-being were invariant across gender (i.e., we tested structural invariance). Based on Ryan and Deci's (2000a) theorizing, we predicted that the conceptual model would be comparable across gender (Hypothesis 4).

Method

Participants

Five hundred and thirty nine adults (males = 271, females = 268) from the United Kingdom volunteered for the study with a mean age of 22.75 years (*SD* = 4.63; range = 18-36). All participants were engaged in a team sport: field hockey (135), cricket (108), netball (86), ultimate Frisbee (55), basketball (42), American football (37), soccer (35), rugby (19), lacrosse (13), and volleyball (9). On average, participants were invested in personal training for seven hours per week (*M* = 6.94; *SD* = 4.83), and had worked with their coach for three years (*M*=3.10; *SD* = 4.15). The majority of participants were involved in their sport at club level (*n* = 370) with fewer participants playing at higher standards of competition: county (39), regional (70), national (48), and international (12).

Measures

Autonomy support. Coach autonomy support was assessed via a modified version of the Health Care Climate Questionnaire (HCCQ; Williams, Grow, Freedman, Ryan & Deci, 1996). Following the approach of Reinboth et al. (2004), seven items were drawn from the HCCQ and adapted to tap the degree to which coaches were perceived by athletes to be autonomy supportive (e.g., "*I feel that my coach provides me choices and options*"). Evidence for the internal consistency and factorial validity of the modified HCCQ has been provided in previous sport based research (Reinboth et al., 2004; Smith et al., in press). Participants responded to the autonomy support items on a 7-point Likert scale (*strongly disagree* = 1; *strongly agree* = 7).

Basic Psychological Needs. The need for autonomy was tapped using a three item measure created by Sheldon, Elliot, Kim and Kasser (2001). A sample item on this scale is "*my choices [e.g., in soccer] are based on my true interests and values*". Consistent with past studies (e.g., Reinboth et al., 2004), the satisfaction of the need for competence was assessed by the five item perceived competence subscale of the Intrinsic Motivation Inventory (IMI; McAuley, Duncan & Tammen, 1989). An example item is "*I think I am pretty good [e.g., at soccer]*". The Acceptance subscale of the Need for Relatedness Scale (NRS; Richer & Vallerand, 1998) was adapted to assess players' perceptions of relatedness with respect to their teammates. Specifically, participants responded to five adjectives asking them to rate the degree to which they felt connected to and by other players on the team (i.e., "I feel…*supported*, *listened to*, *valued*, *understood*, and *safe*). Participants responded to the stem "On this team…" for each basic needs scale and reported their scores on a 5-point Likert scale (for relatedness and autonomy) or a 7-point Likert scale (for competence), ranging from *strongly disagree* to *strongly agree*. The internal consistency, factorial and predictive validity

of these measures have been supported in previous research conducted in the physical domain (e.g., Hagger et al., 2006; Reinboth & Duda, 2006; Standage et al., 2005).

Well/ill-being outcomes. A five item version of the Subjective Vitality Scale (SVS; Ryan & Frederick, 1997) was employed to measure athletes' personal feelings of possessing positive energy. More specifically, this scale was used to assess the degree to which participants felt alive and energetic when playing their chosen team sport (e.g., "*I feel alive and vital*"). Participants responded on a 7-point scale (1 = *not at all true*; 7 = *very true*). Past sport research has supported the internal reliability and predictive validity of this scale (e.g., Gagné et al., 2003; Reinboth et al, 2004).

As an indicator of ill-being, the five item emotional and physical exhaustion subscale from the Athlete Burnout Questionnaire (Raedeke & Smith, 2001) was employed to assess participants' perceptions of energy loss. A sample item includes "*I am worn out by the physical and mental demands [e.g., from playing soccer]*". Participants responded on a 5-point Likert scale (1 = *almost never*; 5 = *almost always*). Previous sport research has shown this subscale to exhibit satisfactory levels of internal reliability as well as providing evidence for temporal stability and construct validity (e.g., Lemyre, Treasure & Roberts, 2006; Raedeke & Smith, 2001).

Procedures

Ethical approval to conduct the study was provided by the investigators' School committee for research with human participants. The principal investigator invited players from nearby clubs to participate in the study. At the time of data collection, participants provided written consent before responding anonymously to a multi-section questionnaire that was administered, either before or after practice, by the principal investigator. Prior to completing the questionnaire, participants were instructed to respond to the questions

independently and as honestly as possible, and were told that there were no right or wrong answers. Participants completed the questionnaire in approximately 15 minutes.

Results

Descriptive Statistics and Pearson Correlations

The descriptive statistics, internal reliability scores and correlation matrix for the study variables are presented in Table 1. Participants exhibited high mean scores for all the scales (i.e., above the midpoint), except for emotional and physical exhaustion which was reported as moderate. The measures employed were also marked by relatively high levels of internal reliability (α = .72-.87).

Overview of the SEM Analyses

SEM (EQS 6.1; Bentler, 2004) was performed to analyze the data. The robust maximum likelihood method was preferred because the Mardia's coefficient was large (normalized estimate = 43.06). In using the robust method, Satorra and Bentler's (1988) adjustment for the chi-square is provided because it generates more accurate standard errors under conditions when data are marked by non-normality. Thus, the Satorra-Bentler χ^2 statistic was considered as a fit index in the present study to evaluate the adequacy of the factor and the structural models. A non-significant Satorra-Bentler χ^2 value indicates an exact fit to the data. However, Marsh, Balla and McDonald (1988) advise caution when interpreting the chi-square statistic as it is sensitive to sample size. Further, they argue that an exact fit indicated by a non-significant chi-square is not obtainable in real-world settings where multiple models could potentially fit the data. Thus, we also evaluated model adequacy using additional goodness-of-fit indices. These were the Robust Comparative Fit Index (R-CFI), the Robust Non-Normed Fit Index (R-NNFI), the Standardized Root Mean Square Residual (SRMR) and the Robust Root Mean Square Error of Approximation (R-RMSEA) along with its 90% Confidence Interval (90% CI). The robust incremental fit indices (e.g., R-CFI) and R-

RMSEA were used in the present study because they are calculated based on the robust chi-square, and not the normal one. According to Hu and Bentler (1999), a good-fitting model is indicated when the CFI and NNFI values are close to or ideally above .95, and the SRMR and RMSEA values are ideally below .08 and .06, respectively. These cutoff values are also applicable to the interpretation of the robust fit indices.

The Measurement and Structural Models

To have confidence in the structural model, it is critical that the measurement of the latent factors is psychometrically sound (Byrne, 1994). To assess the relationship of the indicators to their respective latent factors, we first tested the factorial structure of each scale via Confirmatory Factor Analysis (CFA). The findings showed that all the scales exhibited good fit indices with acceptable factor loadings (median loading = .70). The results of the separate CFA's are available upon request from the principal author. A full measurement model was also tested for divergent validity of the latent factors. An adequate fit was obtained: Satorra-Bentler χ^2 (374) = 853.59, p <.001; R-CFI = .92; R-NNFI = .91; SRMR = .13; R-RMSEA = .05 (90% CI of the R-RMSEA = .044-.053). Similar to the separate factor analyses, all the indicators loaded significantly on their respective constructs.

The hypothesized structural model provided a good fit to the data: Satorra-Bentler robust χ^2 (365) = 648.76, p <.001; R-CFI = .95; R-NNFI = .95; SRMR = .05; R-RMSEA = .04 (90% CI of the R-RMSEA = .033-.043). The standardized regression path coefficients are illustrated in Figure 1. The results revealed support for the hypothesized model with the exception of the regression paths from the needs for competence and relatedness to emotional and physical exhaustion. Ryan and Deci (2000a) propose that the basic needs are inter-related. Based on the principle that dependant variables can not be correlated in SEM analyses, we estimated and found the disturbance terms of the three needs to be inter-related

(autonomy, competence: r = .33; autonomy, relatedness: r = .32; competence and relatedness: r = .20) to be significant ($p < .05$).

Mediational Effects

The mediational effects in the hypothesized model were tested following the SEM approach advanced by Holmbeck (1997). First we tested a model estimating the direct path from the predictor to the outcome variables. The model hypothesizing paths from coach autonomy support to vitality and exhaustion provided a good fit to the data: Satorra-Bentler χ^2 (102) = 269.56, $p < 0.01$; R-CFI = .95; R-NNFI = .95; SRMR = .05; R-RMSEA = .05 (90% CI of the R-RMSEA = .041-.057). In estimating this model, the path from autonomy support to emotional and physical exhaustion was not significant. As such, the mediational condition that a significant relationship should exist between the predictor and outcome variable was only supported for the path from coach autonomy support to vitality (β = .30; $p < .001$).

The next step in testing mediation was to confirm the fit of the constrained model (Holmbeck, 1997). As reported earlier, this model (Figure 1) satisfied the mediational conditions of significant associations between the predictor and mediators and between the mediators and the outcome variable (Baron & Kenny, 1986). The final step was to examine an unconstrained model by adding a direct path from autonomy support to subjective vitality whilst controlling for the psychological needs. Similar to the constrained model, the fit of the unconstrained model was good: Satorra-Bentler χ^2 (366) = 707.31, $p < .001$; R-CFI = .95; R-NNFI = .94; SRMR = .05; R-RMSEA = .04 (90% CI of the R-RMSEA = .034-.043). It should be noted that in the unconstrained model, the path from the need for relatedness to vitality was non-significant (β = .11; $p > .05$). This implies that only the needs for autonomy and competence could potentially serve mediating roles (Baron & Kenny, 1986).

The final step to determining mediation was to perform a chi-square difference test between the less (i.e., unconstrained) and more restrictive (i.e., constrained) models (Holmbeck, 1997). A correction developed by Satorra and Bentler (2001) was used to compare the nested models. This was done because the Satorra-Bentler chi-square is not distributed as a chi square statistic (Satorra & Bentler, 2001). The Satorra-Bentler chi-square difference test indicated no difference between the two models ($\Delta SB\chi^2(1) = 2.87$; $p > 0.05$). That is, the hypothesized model was not improved by adding the path from autonomy support to subjective vitality. Providing evidence for partial rather than full mediation, the path coefficient from autonomy support to vitality, although remaining significant ($p < .01$), reduced to half when controlling for the needs for autonomy and competence (i.e., from $\beta = .30$ to $\beta = .14$). All mediated effects were statistically significant, but there were differences in the size of the specific indirect effects from autonomy support to subjective vitality through the needs for autonomy ($\beta = .08$; $p < .01$) and competence ($\beta = .05$; $p < .001$).

Multi-group SEM Analyses

Aligned with the analytical steps recommended by Bentler (1995), multi-group SEM analyses were conducted to explore the degree to which the hypothesized model was equivalent for male and female athletes. The initial step is to test a model across male and female groups simultaneously without imposing any equality constraints. The purpose of this step is to establish a baseline model for subsequent testing of increasingly restrictive nested models. As shown in Table 2, the baseline model produced a good fit to the data. As is often the case in the psychological literature (e.g., Standage et al., 2005), the baseline model in the present study was not fully identical across groups (see Figure 2). Specifically, three regression coefficients differed across the male and female samples. To compare the same regression coefficients across groups, the un-standardized coefficient (*b*) should be reported (see Hair, Anderson, Tatham, & Black, 1998). The path from autonomy support to the need

for competence was significant for males (b = .26; p < .001) but not for females (b = .10; p > .05). In addition, the path from the need for autonomy to exhaustion was significant for females (b = -.23; p < .01) but not for males (b = -.13; p > .05). Lastly, the path from the need for relatedness to vitality was significant for females (b = .18; p < .05) but not for males (b = .11; p > .05). These paths were not constrained in subsequent steps of invariance testing. In effect, we proceeded to test and confirm the partial invariance (see Byrne, Shavelson & Muthén, 1989) of the baseline model.

The nested models were evaluated based on two criteria. First, the goodness of fit of each model was examined so that it met the guidelines for model fit suggested by Hu and Bentler (1999). Second, the Satorra-Bentler (2001) chi-square difference test was performed to compare nested models. A non-significant difference in chi-square indicates invariance between two nested models. To supplement this approach, differences in the incremental and absolute fit indices of the less and more constrained models were also considered (Bentler, 1995). For example, the more constrained model is suggested to fit significantly worse than the less constrained one when the difference between the CFI values of both models exceeds .01 (Cheung & Rensvold, 2002).

The results (see Table 2) show that the model imposing equality constraints of the factor loadings across gender provided an acceptable fit. However, this model (i.e., Model 2a) was significantly worse than the baseline model according to the Satorra-Bentler chi-square difference test (e.g., $\Delta SB\chi^2(24) = 46.33$, p < .001). The Lagrange multiplier test revealed that the equality constraints of five factor loadings were significantly different across gender groups. Further information on this is available upon request from the principal author. The constraints were released and the model was re-estimated. The revised constrained factor loadings model (Model 2b), without the five aforementioned constraints, was not significantly different compared to the baseline model.

The next step (Model 3) showed that the single factor variance (i.e., autonomy support) in the model was equal across gender groups. No significant differences emerged between the two nested models. The final and most important step with respect to the third aim of the present study was to add the equality constraints of the regression paths linking the latent factors (autonomy support with autonomy/relatedness, and autonomy/competence with vitality) across male and female groups (Model 4). Gender invariance was supported in this final step.

Discussion

Grounded in BNT (Ryan & Deci, 2000a) and extending previous sport research (Gagné et al., 2003; Reinboth & Duda, 2006; Reinboth et al., 2004), one major aim of this study was to test a motivational sequence regarding hypothesized relationships between adult athletes' perceptions of coach autonomy support, basic need satisfaction, and positive and negative indices of well-being. The hypothesized motivational sequence was mainly supported.

Aligned with SDT (Ryan & Deci, 2000a), we found athletes' perceptions of an autonomy supportive coach to correspond to greater satisfaction of their needs for autonomy, competence and relatedness. Consonant with past work (Ratelle et al., 2005; Standage et al., 2006), autonomy support emerged as a positive (and moderate) predictor of the need for autonomy. It makes theoretical sense that a coach perceived as encouraging athlete-decision making and choice would foster athletes' feelings that they are acting with volition and that they are the origin of their own behavior (e.g., Mageau & Vallerand, 2003).

Similar to the findings of Ratelle and associates (2005), an environment characterized by autonomy support emerged as a positive but weak predictor of participants' satisfaction of the need for competence, explaining approximately 3% of the variance. This finding is contrary to Standage et al. (2006) who found teacher-autonomy support to strongly predict

PE students' level of competence, accounting for up to 22% of explained variance. With these discrepant findings in mind, it seems reasonable that the strength of the relationship between autonomy support and satisfaction of the need for competence could vary as a function of setting and/or age. In terms of older athletes playing at a high competitive level, other sources of competence (e.g., coach informational feedback, Horn & Amorose, 1998) or other dimensions of the coach-created environment not measured in this study (e.g., perceptions of the motivational climate, Reinboth & Duda, 2006) may have a stronger influence in supporting players' need for competence. It could also be the case that older and more experienced athletes tend to rely more on recent personal performance information (e.g., Bandura, 1997) than on the degree of autonomy support provided by their coach.

The strongest observed relationship between perceived autonomy support and the players' three basic needs was for relatedness. This finding is parallel to the results from research conducted in the PE setting. For example, in a study by Standage et al. (2006) a teacher-created autonomy supportive environment strongly and positively predicted participants' need satisfaction for relatedness with respect to other PE students in the classroom. The present findings suggest that athletes feel a stronger connection to their teammates when the coach considers their perspective, solicits input, and provides choice. Such a personally empowering environment seems to be more amenable to athletes in developing close and mutually respectful relationships with their teammates. It would be interesting in future work to examine the implications of autonomy supportive features of the social environment created by different significant others (e.g., peers, parents, and the mass media) for the need satisfaction reported by athletic participants at different developmental stages.

Consistent with our hypotheses, the findings suggest that athletes' needs for autonomy, competence and relatedness provide the essential nutriments for eudaimonic well-

being (Ryan & Deci, 2000a). Autonomy and competence were both moderate, strong predictors of participants' subjective vitality. Since subjective vitality is defined as a state of high positive energy emanating from the self (Ryan & Frederick, 1997), athletes are expected to experience it when they perceive themselves as the origin of their actions; that is, when their need for autonomy is satisfied (deCharms, 1968). The results further suggest that adult athletes who perceive high levels of sport-related competence also report feelings of personal vitality in their sport participation. Past studies have shown competence to play a central role in facilitating participants' optimal functioning in youth sport (e.g., Reinboth et al., 2004). In sum and specific to the domain of sport, our findings reinforce the proposition that feelings of effectance and a sense of personal autonomy are necessary to promote eudaimonic well-being and quality engagement in sport activities (Ryan & Deci, 2000a).

Congruent with our hypotheses and similar to the findings of Gagné and colleagues (2003), satisfaction of athletes' need for relatedness was a positive, albeit weak predictor of subjective vitality. Contrary to the present result and Ryan and Deci's (2000a) claim that relatedness is essential for optimal functioning, Reinboth et al. (2004) did not find relatedness to predict vitality among youth team sport players. Future research could employ SEM multi-sample invariance testing to determine whether the hypothesized links between satisfaction of each of the three needs and subjective vitality are equivalent across age groups and settings.

Thwarting of the basic needs is assumed to contribute to poor mental health (Ryan & Deci, 2000a; 2000b). In the present study, athletes who expressed low perceptions of autonomy reported higher levels of emotional and physical exhaustion connected with their sport participation. This result suggests that when athletes perceive a lack of personal causation and diminished self determination the demands of participating in sport can drain feelings of emotional and physical energy (see also Lemyre et al., 2006). Under conditions when athletes perceive their energy resources to be exhausted, athletes are at a higher risk of

under-performing, incurring injury, experiencing diminished benefits from training, and dropping out from sport (Gould, Tuffey, Udry & Loehr, 1996).

Inconsistent with our hypotheses, satisfaction of the needs for competence and relatedness were unrelated to athletes' sport-related emotional and physical exhaustion, despite a significant bivariate correlation for competence. Therefore, the present results and past sport research (e.g., Reinboth et al., 2004) provide only partial support for Ryan and Deci's (2000b) proposition that all three needs are relevant to the occurrence of ill-being in a sport setting. Furthermore, aligned with other research in sport (Gagné et al., 2003; Reinboth & Duda, 2006), our findings corroborate Sheldon and Bettencourt's (2002) arguments, who claim that psychological need satisfaction is more pertinent in understanding the promotion of well-being, as opposed to explaining the absence of ill-being. Collectively, our findings emanating from SEM, and the low bivariate correlation between vitality and exhaustion, provide evidence that well-being does not necessarily lie on the same continuum as ill-being; they are separate phenomena (Ryan & Deci, 2001). However, more research grounded in BNT is warranted to establish if these claims hold true in sport and other domains. Further, future studies might examine how the three psychological needs relate to other facets of burnout (e.g., sense of personal accomplishment and sport devaluation; Raedeke & Smith, 2001), as well as alternative indices of ill-being (e.g., anxiety).

Mediational Role of the Psychological Needs

Drawing from BNT (Ryan & Deci, 2000a), a second aim of the present work was to test the mechanisms through which social environmental factors can predict both well- and ill-being of individuals within the context at hand. We found that the needs for autonomy and competence partially mediated the pathway from coach autonomy support to athletes' levels of subjective vitality. The results of the specific indirect effects imply that the need for autonomy (in contrast to competence) was marginally more important in explaining the

autonomy support-vitality relationship. From a practical standpoint however, it appears that coaches can play a role in improving and/or maintaining the positive energy of their athletes in training and competition by supporting athletes' needs for both autonomy and competence.

Contrary to theoretical predictions (Deci & Ryan, 2000) and findings reported by Reinboth and Duda (2006), athletes' need for relatedness did not mediate the relationship between the coaching environment and athletes' feelings of being alive and vital. In explicating this result, it is important to note that in Reinboth and Duda's (2006) study, the relationship between a task-involving climate and vitality over the course of a competitive season was partially mediated by relatedness operationalized in terms of athletes' interactions with the coach, rather than a sense of connection with one's teammates. Based on Reinboth and Duda's (2006) findings and the present results, it seems sagacious to measure relatedness with respect to both the coach *and* teammates when examining its potential mediational role in the autonomy support-subjective vitality relationship. In explaining the present null finding from a statistical point of view, it is important to recognize that autonomy and competence potentially accounted for a higher proportion of the shared variance in the prediction of athletes' reporting positive energy. Thus, there may have been insufficient unique variance that could be accounted for by relatedness (especially when considering the observed significant, positive correlation between relatedness and subjective vitality). With that said, the ecological validity of the results would have been compromised had we examined the potential mediational role of each psychological need in separate analyses.

The direct path from autonomy support to emotional and physical exhaustion was non-significant and, therefore, we could not test the hypothesized mediation of the psychological needs in this case (Holmbeck, 1997). This result is contrary to other research indicating that the occurrence of sport-related burnout is a function of the social environment created by significant others in this context (e.g., Krane, Greenleaf & Snow, 1997). Reinboth

and Duda (2004) found that adolescent athletes who perceived the coach to emphasize more ego-involving aspects of the motivational climate were more likely to report experiencing emotional and physical exhaustion. It might be the case that coach-provided autonomy support is predictive of other facets of burnout (Raedeke & Smith, 2001) not assessed in the present work or that other dimensions of the social environment (e.g., the degree of coach controllingness and/or the ego-involving features) are more relevant to athletes' feelings of depleted emotional and physical energy.

Multi-group Analyses

BNT assumes that the significance of basic psychological need satisfaction to human functioning is universal across all groups (Ryan & Deci, 2000a). In previous work, this postulate has been supported in analyses of invariance across culture (e.g., Deci, et al., 2001). In the current research, we theorized that the hypothesized relationships between autonomy support, basic need satisfaction and well-being would remain invariant for adult male and female athletes. Given that three regression paths (i.e., autonomy support to competence, autonomy to exhaustion, and relatedness to subjective vitality) were significant for one gender group but not the other in the baseline model, we could not proceed to test their equality constraints. Although these paths were not constrained to be equal in subsequent steps of invariance testing, they were relatively similar in size in the two gender groups and in the same direction. Taken in their totality, the results of the full SEM multi-sample analyses partially supported Ryan and Deci's (2000a) invariance hypothesis.

The partial support for gender invariance in the present study is consistent with previous work testing the tenets of self-determination frameworks in physical education (e.g., Ntoumanis, 2005; Standage et al., 2005). All in all, the findings stemming from the present SEM multi-sample analysis have implications for male and female athletes in the sport domain. Drawing from the present findings, it appears that it is not necessary for coaches to

consider an athlete's gender when working to develop an autonomy supportive environment to facilitate basic need satisfaction and ensuing vitality.

Limitations and Conclusions

Overall, our findings supported the hypothesized sequence of relationships proposed in BNT (Ryan & Deci, 2000a). As these results stem from cross-sectional data, future studies should test the links between environmental factors, psychological needs and indices of athletes' well- and ill-being via longitudinal and experimental designs. As the present work relied on self-report instruments to measure the targeted variables, this line of inquiry would be advanced if researchers in subsequent studies employed objective measures of the social environment (e.g., coach behavioral observations) and athletes' welfare (e.g., injury occurrences, cortisol responses) in addition to subjective measures. Another direction for future sport-related research would be to test the hypothesized motivational sequence between autonomy support to need satisfaction and ensuing well- and ill-being in a multi-level structure (e.g., considering variation as a function of the participant, team, and sport).

In summary, the study findings support the tenets of BNT (Ryan & Deci, 2000a), and reinforce the importance of a coach created autonomy supportive environment to the fostering of basic need satisfaction and occurrence of optimal functioning among male and female adult athletes.

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Table 1

Descriptive statistics, Cronbach's Alpha Coefficients and Correlations for the Observed Subscale Scores

Variable	*M*	*SD*	Range	α	1	2	3	4	5	6
(1) Autonomy support	4.98	.93	1-7	.85	–					
(2) Autonomy	3.48	.69	1-5	.79	.26**	–				
(3) Competence	5.01	.88	1-7	.72	.17**	.33**	–			
(4) Relatedness	3.99	.65	1-5	.86	.40**	.35**	.30**	–		
(5) Subjective Vitality	5.32	.95	1-7	.81	.25**	.33**	.33**	.30**	–	
(6) Exhaustion	2.31	.85	1-5	.88	–.01	–.13**	–.13**	–.08	–.15**	–

Note. Exhaustion = Emotional and physical exhaustion.
** $p < .01$

Table 2

Goodness of Fit Indices for the Multi-Group SEM Analysis Across Gender.

Model	SB χ^2	*df*	ΔSB χ^2	Δdf	RCFI	RNNFI	SRMR	RRMSEA (90% CI)
Model 1	1157.06	790	–	–	.94	.94	.063	.042 (.036-.047)
Model 2a	1203.34	814	46.33***	24	.94	.93	.069	.042 (.037-.047)
Model 2b	1176.94	809	19.00	19	.94	.94	.065	.041 (.036-.046)
Model 3	1178.18	810	1.35	1	.94	.94	.066	.041 (.036-.046)
Model 4	1180.52	813	2.54	3	.94	.94	.067	.041 (.036-.046)

Note. Model 1 = Baseline model; Model 2a = Factor loading coefficients constrained; Model 2b = Factor loading coefficients constrained (released equality constraints of five non-invariant factor loadings); Model 3 = Factor loading coefficients and factor variance constrained; Model 4 = Factor loading coefficients, factor variance and regression paths constrained. SBχ^2 = Satorra-Bentler chi-square; RCFI = Robust Comparative Fit Index; RNNFI = Robust Non-Normed Fit Index; SRMR = Standardized Root Mean Residual; RRMSEA = Robust Root Mean Square Error of Approximation; 90% CI = 90% Confidence Interval of the RRMSEA.
*** $p < .001$

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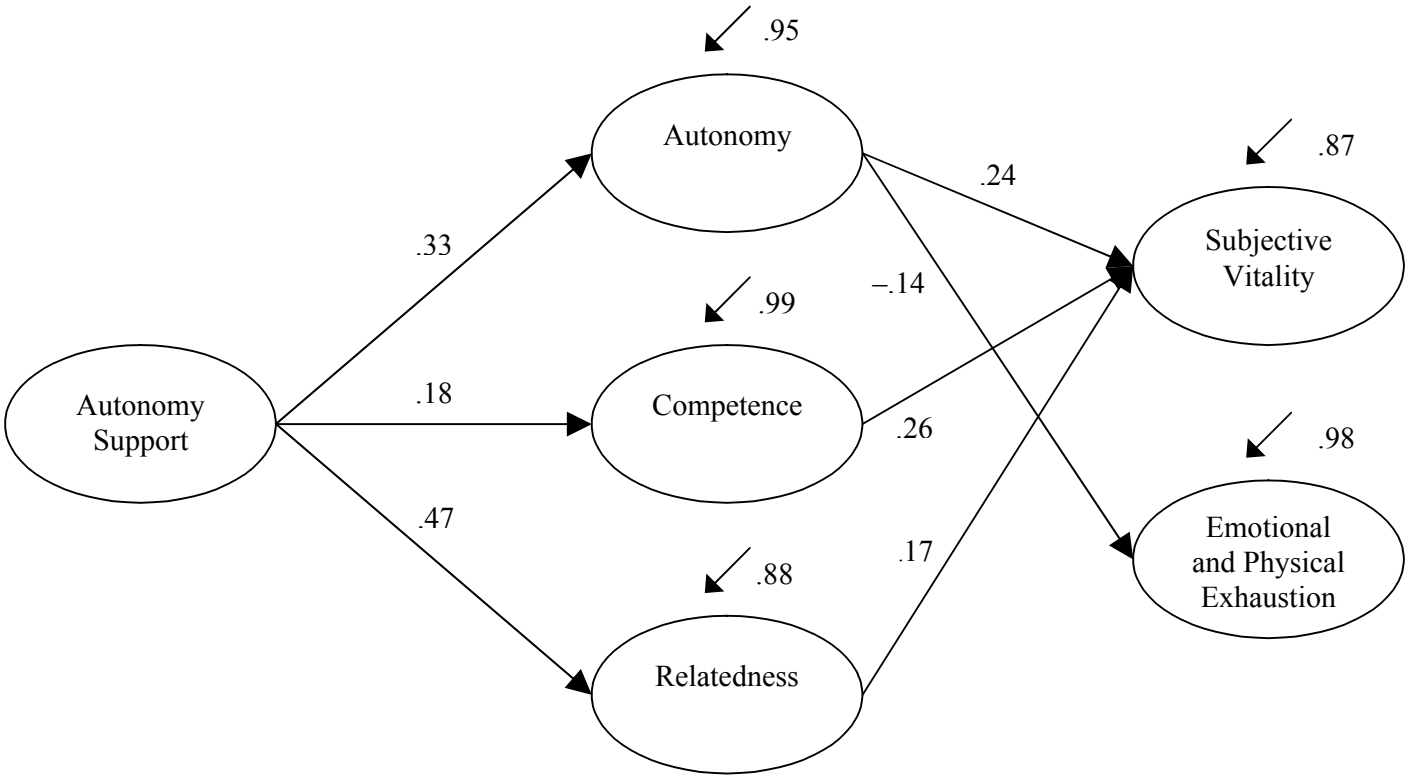
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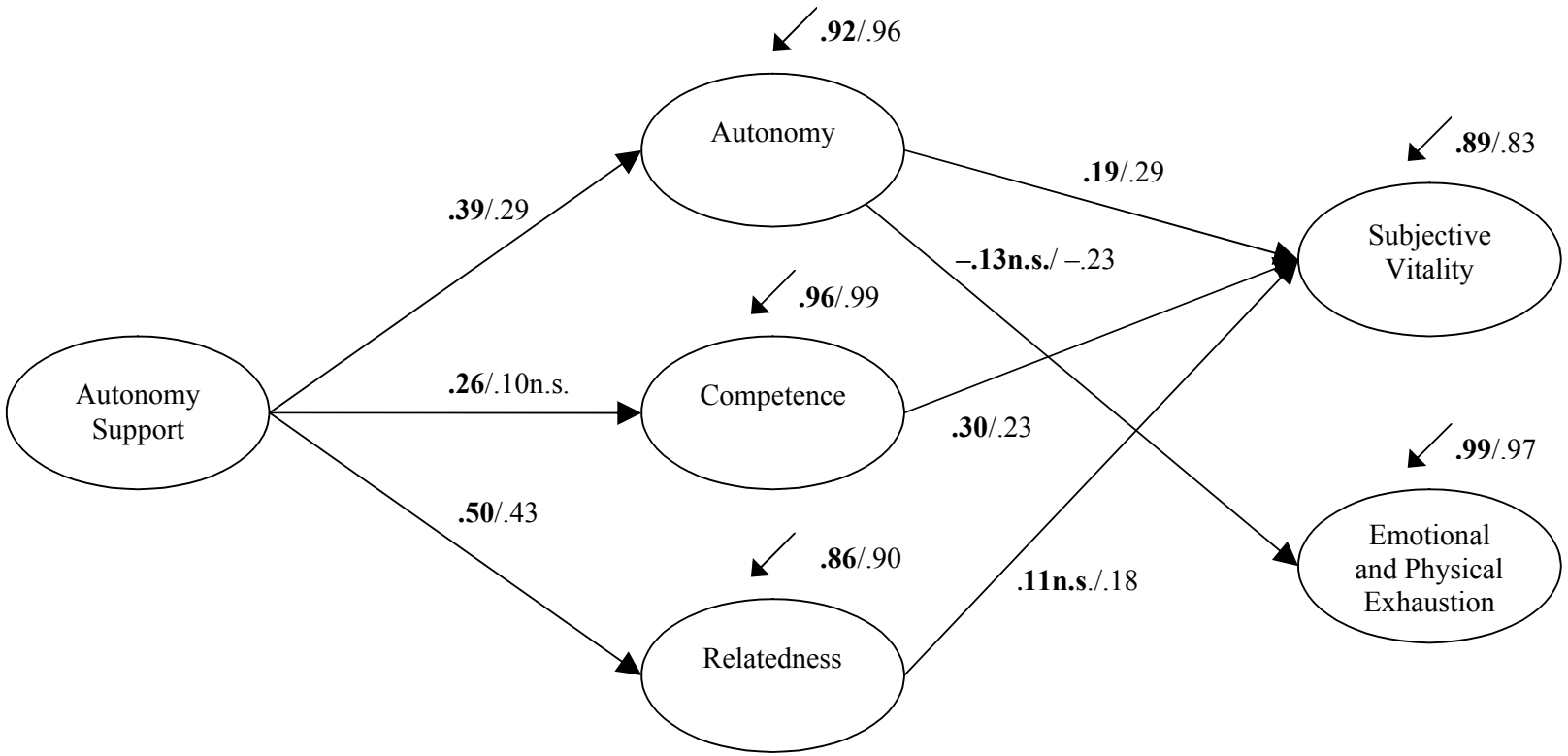
Figure 1.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Emotional and Physical Exhaustion
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Relatedness

Figure 2.